Introduction to Electronics (Practice paper – 6)

Topic: Op-Amp

1. Determine the expressions/values of v_o (V_0) in the following circuits:

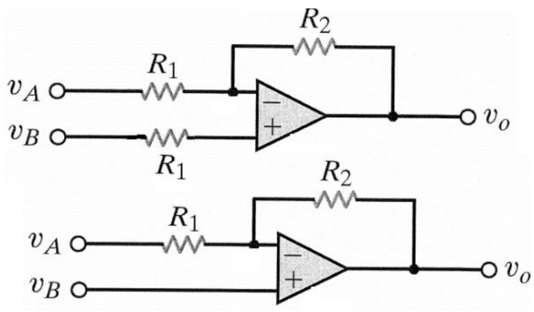

Fig. 1a (i & ii)

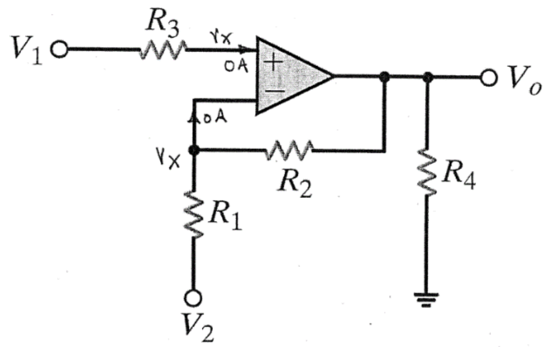

Fig. 1b

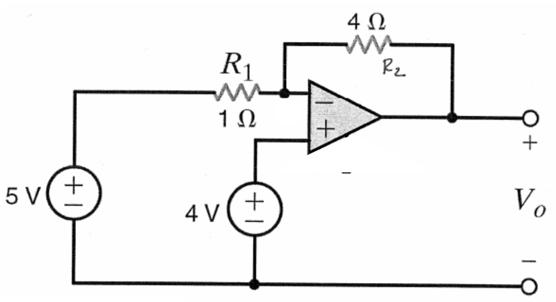

Fig. 1c

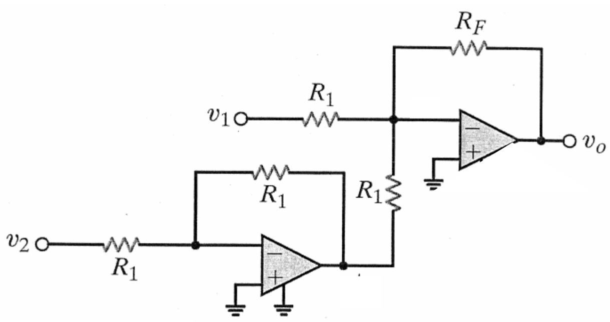

Fig. 1d

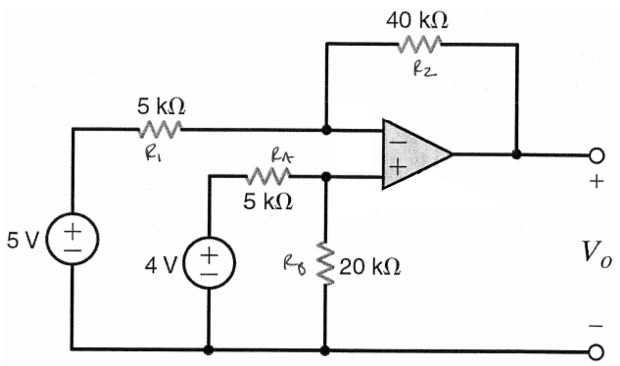

Fig. 1e

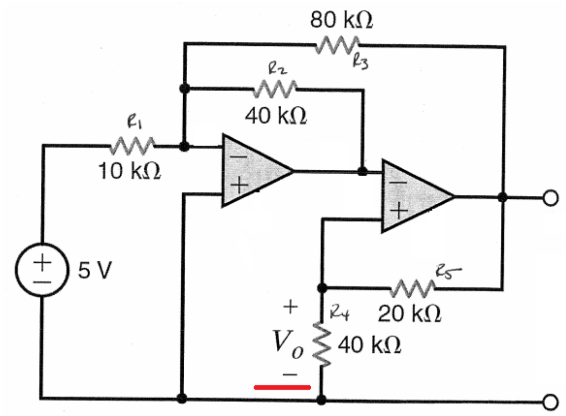

Fig. 1f

2. You have given a bunch of 10 kΩ resistors and an Op-Amp. Design a circuit that will produce the following output (V_0). $V_0 = -2V_1 - 4V_2$

3. In the Op-Amp circuit shown in Fig. 2, find I_0 and I_S if $V_S = 1$ V and $R_L = 1$ kΩ. Also, plot the variation of I_0 with R_L.

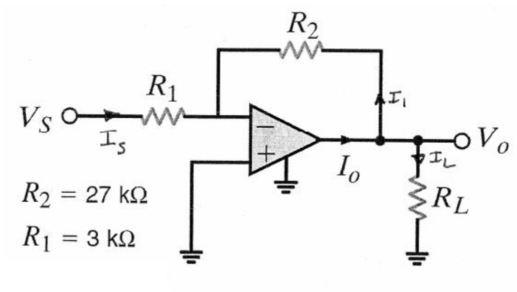

Fig. 2

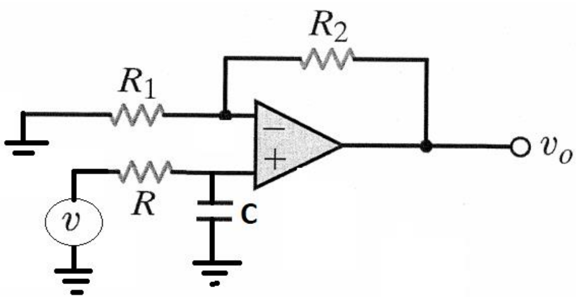

Fig. 3

4. Fig. 3 shows a low-pass filter. Estimate the value of feedback resistor R_2 such that the 'pass-band' gain of the total circuit is 100. Given that C = 0.2 μF and R_1 = 1 kΩ. Also calculate the value of resistor R for realizing a cut-off frequency of 2 kHz.

5. For an Op-Amp, the differential gain (A_d) is 100. When 1 V is applied (common) to both the inputs, the output voltage measured is 0.01 V. Calculate the CMRR of the Op-Amp in dB.

6. Consider the circuit in Fig. 4, (a) Derive the expression for the output voltage v_O in terms of v_{I1} and v_{I2}. (b) Determine v_O for v_{I1} = +5 mV and v_{I2} = (−25 − 50 sinωt) mV.

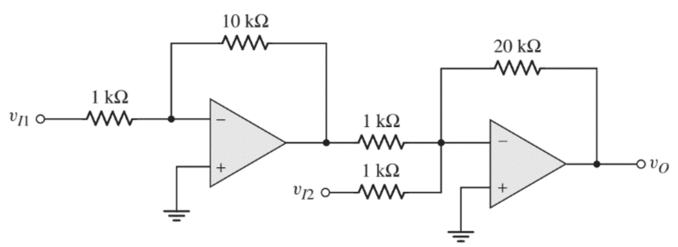

Fig. 4

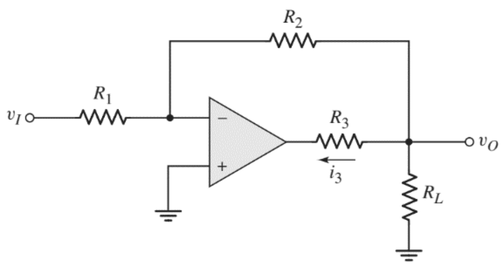

Fig. 5

7. In the circuit shown in Fig. 5, derive the expression for i_3 in terms of v_I.

8. Consider the circuit shown in Fig. 6. (a) Determine the ideal voltage gain. (b) Find the actual gain if the open-loop gain (A_{od}) of the op-amp is $A_{od} = 5 \times 10^3$. (c) Determine the required value of A_{od} in order that the actual voltage gain be within 0.2 percent of the ideal value.

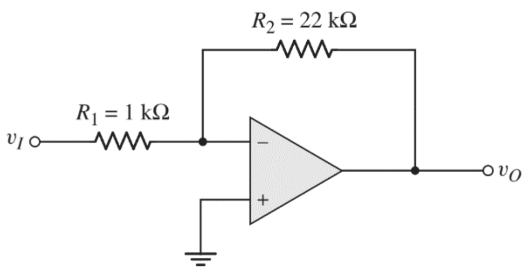

Fig. 6

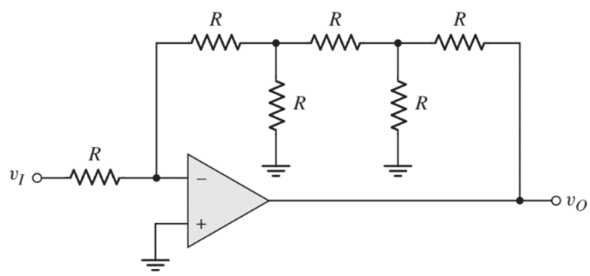

Fig. 7

9. For the inverting op-amp amplifier shown in Fig. 7, determine the gain $A_v = v_O/v_I$.

10. The circuit shown in Fig. 8 is a first-order high-pass active filter. Determine how the gain of this circuit [$A_v = v_O/v_I$] is dependent on frequency i.e. find the voltage transfer function.

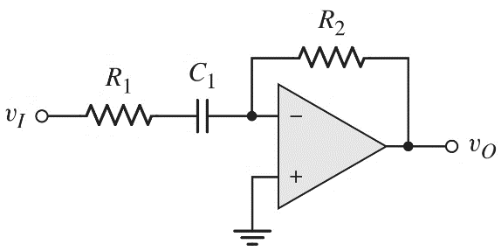

Fig. 8

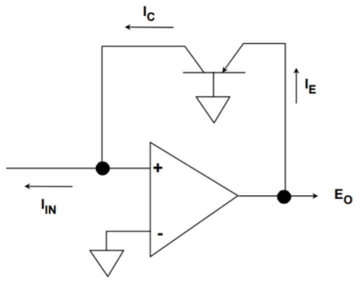

Fig. 9

11. In Fig. 9, show that $E_0 = \frac{kT}{q}\ln(\frac{I_{IN}}{I_{ES}})$, where, I_{ES} is the reverse saturation current.

12. If an op-amp has a slew-rate of 5 V/μs, find the full-power bandwidth for a peak output voltage of (a) 5 V, (b) 1.5 V, and (c) 0.4 V

13. An amplifier system is to be designed to provide an undistorted 10 V peak sinusoidal signal at a frequency of f = 12 kHz. Determine the minimum slew rate required for the amplifier.

14. An audio amplifier system is to use an op-amp with an open-loop gain of $A_{Od} = 2 \times 10^5$ and a dominant-pole frequency of 10 Hz. The maximum closed-loop gain for the audio amplifier is 100. Determine the closed loop bandwidth of the amplifier.

15. For Fig. 10, neatly sketch the output voltage V_0 when V_{in} is a sine wave of amplitude 2 V (zero to peak). Consider the op-amp as ideal and zero voltage drop across the diode in forward bias.

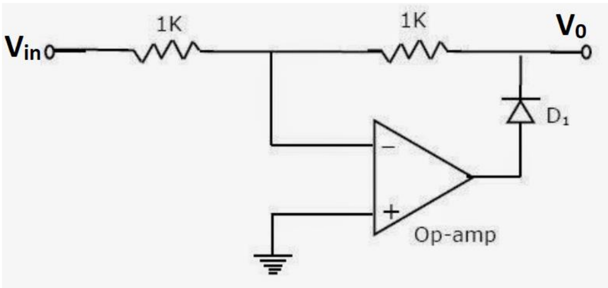

Fig. 10